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B8A

(71) Applicant
Engelbrecht + Lemmerbrock GmbH + Co (FR Germany),
6 Neuerostrasse, 4520 Melle, Federal Republic of Germany

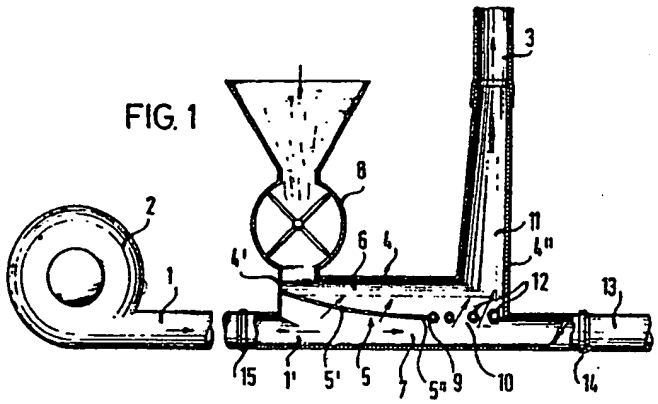
(72) Inventor
Hermann Johanning

(74) Agent and/or Address for Service
Baron & Warren,
18 South End, Kensington, London W8 5BU

(54) Pneumatic conveyor

(57) The pneumatic conveyor for grain consists of a horizontal conveyor line (1, 7) and a horizontal conveying space (6) which accepts the falling grain at one end (4a) and whose discharge end terminates in an upward-narrowing vertical conveyor tube (11) adjacent to the horizontal conveyor line (1, 7), the grain being conveyed on a flow tray (5) by a bypass flow from the conveyor line (6) or mechanically into the lower part of the vertical conveyor tube (11) where it is entrained in the air flow from the line (7) which increases in velocity as it moves up to the conveyor tube (11).

FIG. 1



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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

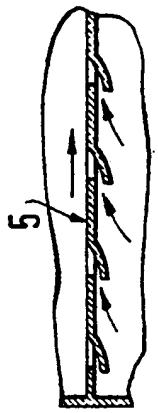


FIG.2

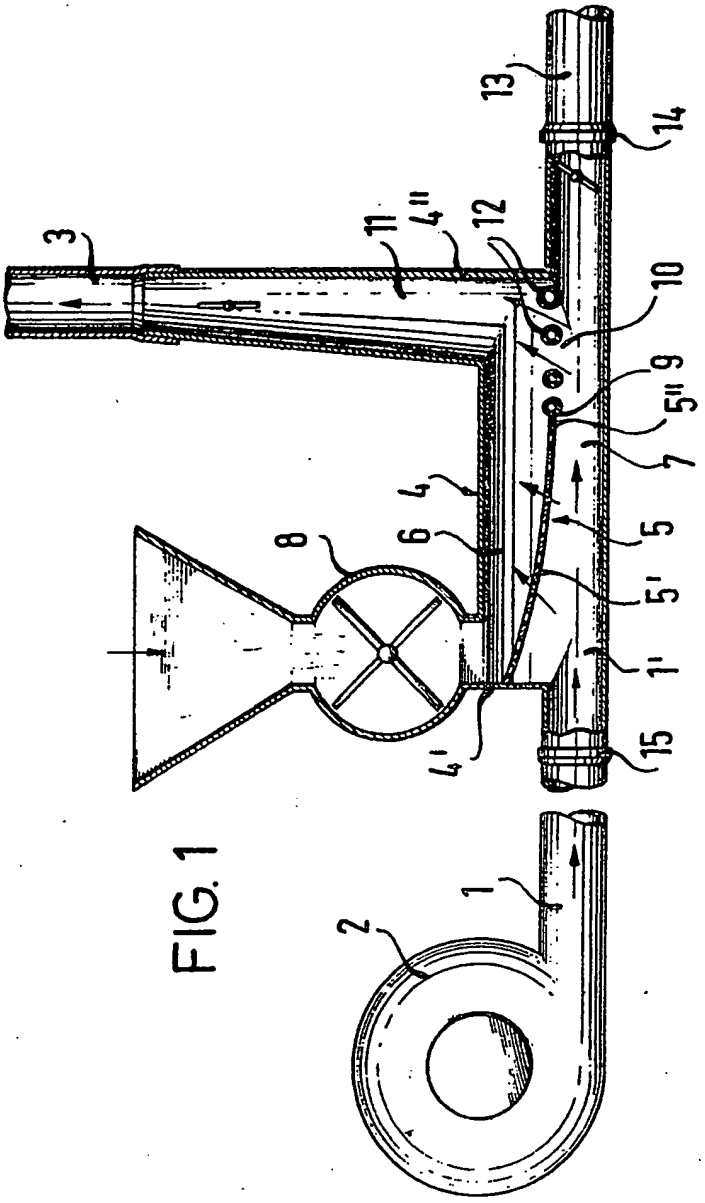


FIG.1

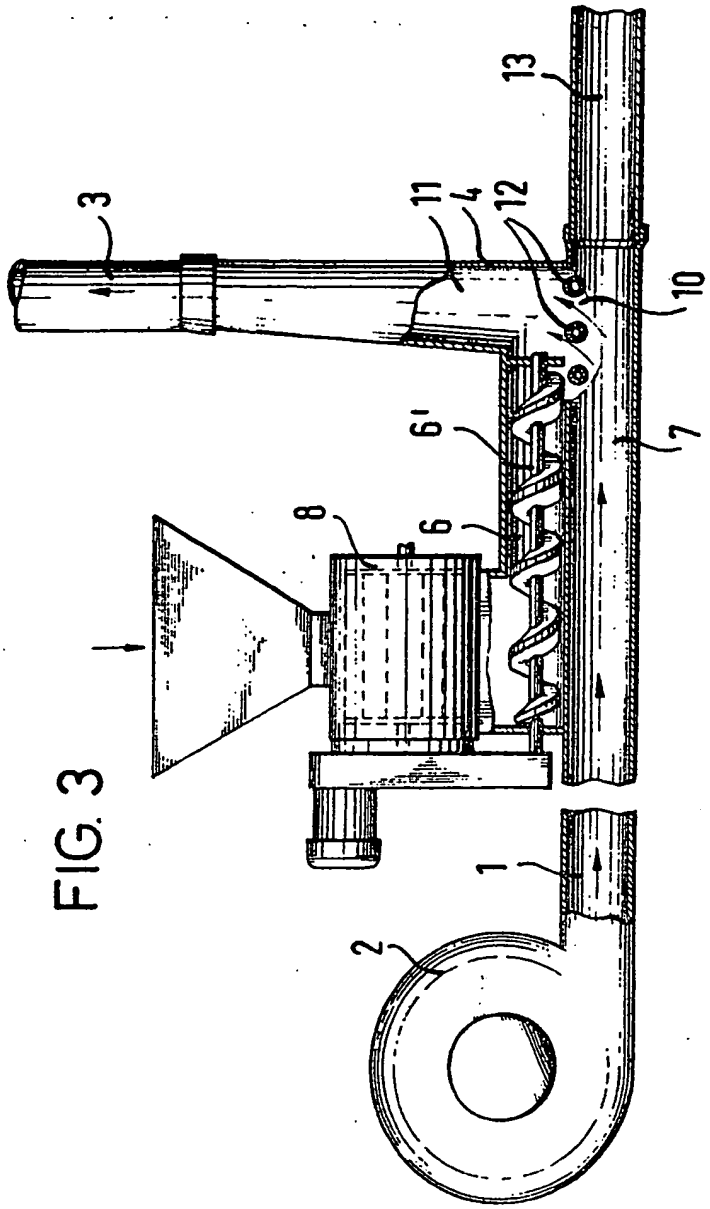


FIG. 3

FIG. 5

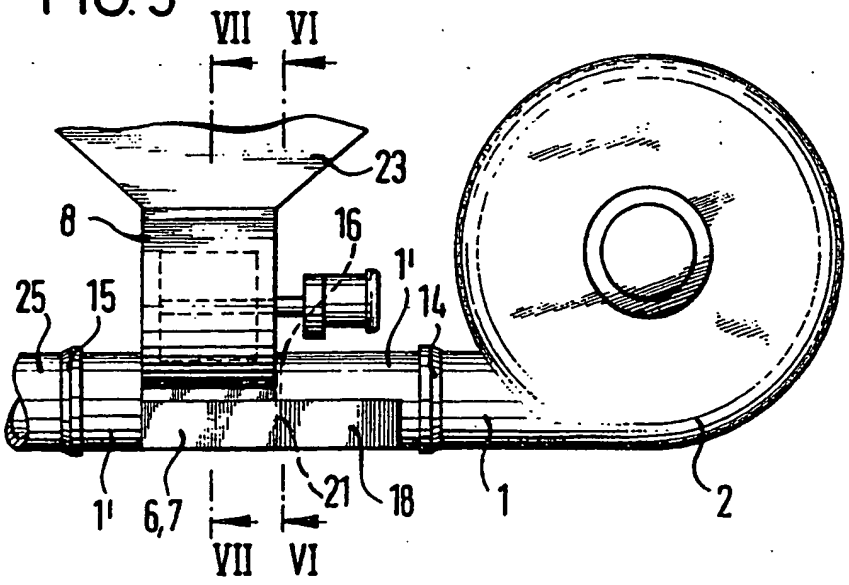

VII
VI
23
8
16
1'
25
15
14
1'
6,7
21
18
1
2
VII
VI

FIG. 4

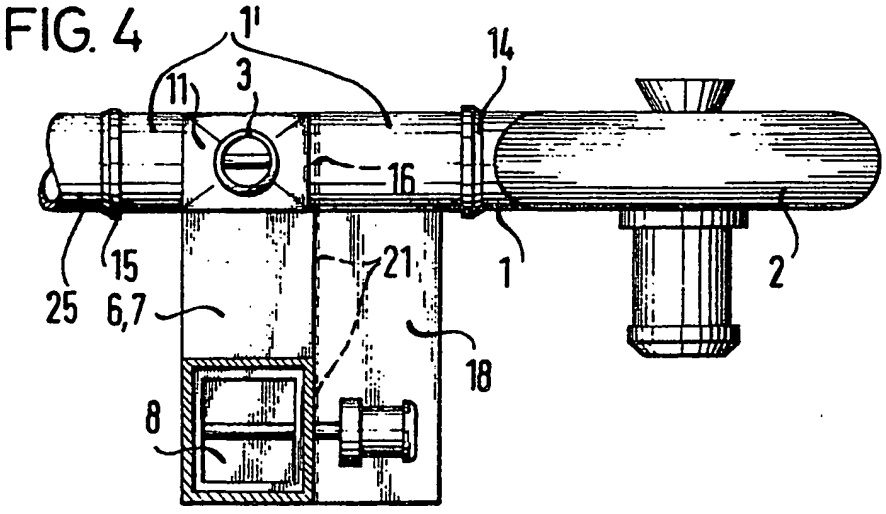

1'
14
11
3
16
15
25
6,7
21
1
2
18
8

FIG. 7

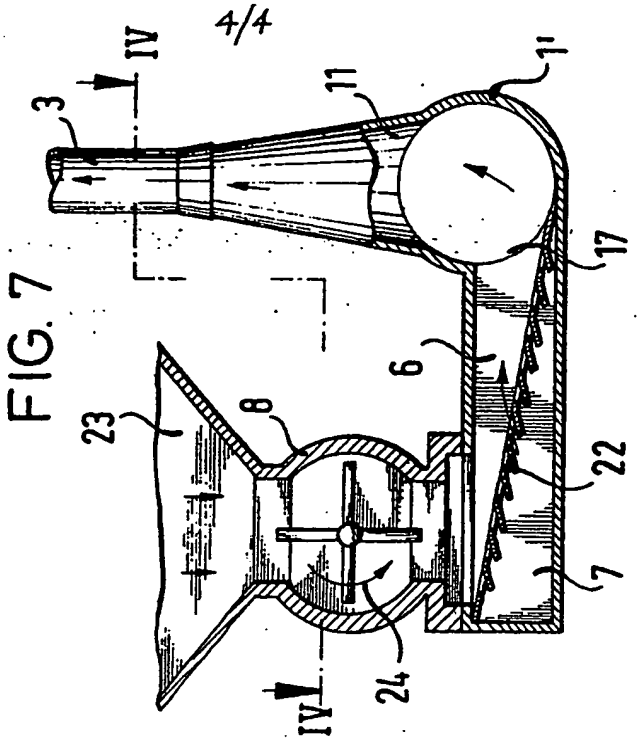
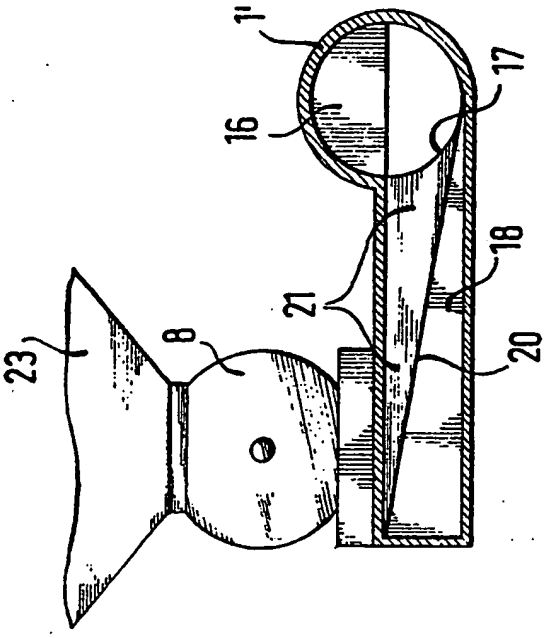


FIG. 6



SPECIFICATION

Pneumatic conveyor

The invention relates to a pneumatic conveyor for grain, a metered supply of grain being passed into a horizontal conveyor line of the conveyor, which line leads into a vertical conveyor tube.

In the case of conventional vertical pneumatic conveying devices for grain, for example for filling a tower silo, the grain is fed via a bucket wheel or through suction nozzles, it is necessary to connect a horizontal conveyor line via a 90° deflector in order to convey the grain vertically upwards into an upright conveyor tube. When grain is being conveyed by means of conveying air such deflectors possess an extremely high flow resistance, and thus this method of conveying requires a correspondingly high fan output.

An object of the invention is to avoid the high flow resistance of 90° deflectors in pneumatic conveying installations with vertical conveyor tubes.

It is also an object to keep the structural height of the conveying apparatus as low as possible.

In a pneumatic conveyor for grain having a metered supply of grain passing into a horizontal conveyor line which line leads into a vertical conveyor tube, according to the invention a horizontal conveying space is provided between the horizontal conveyor line and the vertical conveyor tube, and arranged to receive the grain falling from the supply, the horizontal conveying space having a discharge end leading into an upwardly-narrowing vertical conveyor tube adjoining the horizontal conveyor line and leading to the vertical conveyor tube.

This solution enables 90° deflectors with high flow resistances to be avoided, as only the conveying air is now deflected from the horizontal into the vertical direction. At this point of deflection of the conveying air, the grain from the conveying space is suspended in the air and passed to the vertical conveying air flow, is taken up by this conveying air and is only subsequently entrained upwards in a rapid flow in the narrowed, vertical conveyor tube by the air speed which increases therein.

According to an embodiment of the invention, grain which is metered into the conveying space is fed, on a flow tray and suspended in the air, to the lower part of the vertical conveyor tube by a conveying air bypass which passes upwards through the flow tray, or this feeding can be effected mechanically from the conveying space by a screw conveyor, a conveyor belt or the like.

In order to enable the structural height of the conveying space to be kept low, the flow tray of the conveying space forms the upper wall of the horizontal conveyor line for a desired length immediately upstream of the vertical conveyor tube.

It is possible to reduce the structural height of the apparatus even further, in order for example to enable harvested grain to be discharged from dumper trucks into a filling hopper set on the bucket wheel without special tubes or the like laid at a lower level being necessary. The procedure here is that the horizontal conveyor line is provided at one point in its upper cross-section with a baffle, upstream of which the conveyor line is provided with a lateral, chamber-shaped bypass which terminates below a flow tray of a conveying space lying approximately perpendicular to the conveyor line and having a bucket-wheel feed at the top, the height of the conveying space with the flow tray being in the vertical zone of the lower half of the cross-section of the horizontal conveyor line and leading, downstream of the baffle, into the lower part of the upright conveyor tube.

It is advantageous to design a length of the horizontal conveyor line with the bypass, the conveying space interacting with a bucket-wheel feed and the lower part of the vertical conveyor tube as a unit, which can at any time be incorporated into the conveyor line.

A pneumatic conveyor according to the invention can be operated with a compressed-air or suctionair fan, a centrifugal separator for the grain being incorporated, in suction-air operation, in the vertical conveyor tube above a silo or store, and the suction fan then being connected to the exit-air pipe of this separator.

The invention will now be described with reference, by way of example, to the accompanying partly diagrammatic drawings, in which:

Figure 1 is a schematic side view of one embodiment of pneumatic conveyor according to the invention,

Figure 2 is a schematic view of a flow tray forming part of the conveyor of Figure 1,

Figure 3 is a schematic view of another embodiment of pneumatic conveyor according to the invention and incorporates a mechanical conveyor,

Figure 4 is a plan view of conveying apparatus according to the invention viewed from the line 1-1 of Figure 7 and incorporating a lateral chamber like bypass for reducing the overall height of the apparatus;

Figure 5 is a side view of the apparatus of Figure 4;

Figure 6 is a cross-sectional view taken on line III-III of Figure 5, and

Figure 7 is a cross-sectional view taken on line IV-IV of Figure 5.

According to the embodiment shown in Figures 1 and 2, a pressure line 1 is supplied with conveying compressed air by a fan 2, the speed of this air enabling it to convey grain upwards in a vertical conveyor pipe 3.

The pressure line 1 terminates in a lower

space of a container 4, this space being matched to the cross-section of the pressure line. This container 4 is sub-divided into an upper space 6 and a lower space 7 by a flow tray 5 which in practice forms the upper wall of a length of line 1. The flow tray 5 can, for example, be designed as is shown in partial longitudinal section in Figure 2, or can alternatively be designed as a sheet with lengthwise slits whose width does not permit falling grain to pass through from chamber 6. One part of the flow tray 5, beneath the immediate discharge of a bucket wheel 8 which can be charged with grain from a store and can be driven to rotate, is advantageously inclined downwards, as at 5a, starting from an end wall 4a and then leads into a horizontal part 5b, which ends at such a distance from a terminal end wall 4b that a free upward passage 10 is formed between an end edge 9 of the flow tray 5 and the terminal end wall 4b, the cross-section of this passage corresponding to the cross-section of the lower container space 7. Above this passage 10, an upright, widened exit 11 adjoins the housing 4 and leads in an upwardly narrowing manner into a narrowed upward conveyor tube 3. As a result of the narrowed cross-section of the tube 3 the conveying air speed necessary for the vertical conveying of the grain is achieved. In order to obtain favourable deflection of the conveying air upwards out of the lower container space 7 through the passage 10, structural elements such as pipes 12, rods, guide plates or the like may be installed in the passage 10 parallel to the edge 9 of the flow tray.

The grain falls directly from the bucket wheel 8 onto the inclined part 5a of the flow tray 5, and is entrained on the flow tray by a part of the conveying air which passes upwards from the lower conveyor line 7 through the flow tray 5, so that the grain flows slowly to the end edge 9. At this end edge it is picked up in the passage 10 by the conveying air flowing upwards from the lower conveyor line 7 and is first entrained slowly upwards, in suspension, through the widened portion 11 and by the conveying air whose speed is low in this portion, and is then carried abruptly upwards over the desired conveying height by the increasing speed in the narrowed, upright conveyor pipe run 3.

As a result of the slow flow of the grain on the flow tray 5 and the reduced conveying air speed above the passage 10, which however does permit the grain to be suspended and entrained by the conveying air upwards into the connection 11, abrupt deflection of the grain is avoided, but the necessary speed for the upward conveying is achieved by the narrowing of the upright conveyor tube 3.

A horizontal conveyor line 13, capable of being shut off, can also be connected to the container 4, the part 5b of the flow tray 5 then being pivotable upwards about the end edge 9 to shut off the upper container space 6, so that at the end of the inclined flow tray part 5a the grain falls into the conveying air stream of the lower conveyor line 7, and is entrained and fed to the horizontal, narrowed conveyor tube 13. In this case the conveyor tube 3 must then be sealed, while in the case of vertical conveying the line 13 must be sealed.

As mentioned in the introduction, the slow conveying flow in the upper conveying space 6 can also be effected mechanically by means of a conveyor belt, a screw conveyor or the like, as is shown for example in Figure 3, in which equivalent parts to Figure 1 are given the same reference figures. In this case, where the method of operation is the same as described for Figures 1 and 2, a screw conveyor 6a rotating at a slow speed is situated in the upper space 6, advantageously designed as a pipe, and conveys the grain, falling from the supply 8, in a slow stream to the passage 10 through which the conveying air flows upwards from the lower conveyor air line 7 which is parallel to the conveying space 6 and prolongs the conveyor tube 1. The air flow speed is reduced in passage from line 7 through space 10 to space 11. The same events then take place as described with reference to Figure 1.

In both cases shown in Figures 1 and 3, the cross-sections of the lower space 7, the passage 10 and the upright narrowed conveyor pipe 3 are selected to be of substantially equal size. It is also possible to work with a suction fan instead of a pressure fan, the procedure in this case being that the conveyor line 1 forms the inlet for the conveying air and the vertical conveyor line 3 terminates in a centriffugal separator to which is connected a suction line leading to a suction fan.

As already mentioned the structural height of the conveying apparatus can be still further reduced relative to the embodiment shown in Figures 1 to 3 by the embodiment shown in Figures 4 to 7.

In Figures 4 to 7, the same reference figures are used for identical parts from Figures 1 to 3. In accordance with this example, a pressure line 1 is again connected to a pressure fan 2. A unit can be inserted into this pressure line between the separation points 14 and 15, extending over a length 1a of the pressure line 1. The length 1a of the pressure line is provided with a baffle 16 which covers the upper cross-section of the line and hence constricts the cross-section of the length 1a. Upstream and downstream of this baffle 16, the length 1a is provided in its lower part with a lateral aperture 17 between the baffle 16 and the floor of the line. Upstream of the baffle 16 a back-up chamber 18 laterally adjoins this aperture 17, and a back-

up pressure is created in this back-up chamber 18 by the baffle 16. A conveying space 6,7 of the same height is connected to this back-up chamber 18 in the direction of the conveyor line 5 and terminates downstream of the baffle 16, via the aperture 19, in the lower part of the conveyor line 1a. The connection between the two chambers 18 and 6,7 is partly blocked due to the fact that an approximately triangular blocking wall 21 is installed above a straight or curved incline 20 extending at an angle from outside to the floor of the conveyor line 1a, the two chambers 18 and 6,7 being connected below this blocking wall.

A perforated flow-plate 22 extending at an angle from outside to the floor of the conveyor line 1a is installed in the conveying chamber 6, in the plane of the incline 20 of the chamber 18, and terminates in the lower part of the conveyor line 1a which is open laterally at the bottom in the region of the chamber 6. Above the outer end of the flow-plate 22 the chamber 6,7 is directly connected to the discharge of a bucket wheel 8 having an upper feed hopper 23.

In operation, the back-up pressure generated in the chamber 18 by the baffle 16 acts on the space 7 below the flow-plate 22 in such a way that the falling grain fed in via the bucket wheel 8 is conveyed, on the inclined flow-plate and suspended as a result of the back-up pressure, towards the conveyor line 1a downstream of the baffle 16. The bypass conveying is effected by the pressure difference in the air flow upstream and downstream of the baffle 16, and is further supported by the fact that the direction of rotation 24 (Figure 7) of the bucket wheel 8 delivers the grain towards the pressure line 1a.

The flow tray 22 terminates in the pressure line 1a at the point where the upward-narrowing connecting pipe 11 of the vertical conveyor tube 3 adjoins, so that the suspended grain is here picked up by the conveying air stream and entrained upwards.

The entire unit described can be removed from the vertical conveyor tube 3 by loosening the connectors 14,15 and the pipe 11, and can be installed by the reverse procedure. In this case again, the upright conveyor tube 11,3 can be shut off, and a horizontal or inclined conveyor line 25 can be connected instead of the length of line 1a which is closed at 15. A suction fan can also be used in the embodiment according to Figures 4 to 7, in which case a bucketwheel feed may be dispensed with.

CLAIMS

1. Pneumatic conveyor for grain having a metered supply of grain passing into a horizontal conveyor line which line leads into a vertical conveyor tube, wherein a horizontal conveying space is provided between the horizontal conveyor line and the vertical conveyor tube, and arranged to receive the grain falling from the supply, the horizontal conveying space having a discharge end leading into an upwardly-narrowing vertical conveyor tube adjoining the horizontal conveyor line and leading to the vertical conveyor tube.

2. Pneumatic conveyor according to claim 1, wherein the horizontal conveying space which receives the falling grain possesses an inclined flow tray through which part of the conveying air is passed from below into the horizontal conveying space and feeds the grain to the discharge of the conveying space and to the lower part of the upwardly narrowing vertical conveyor tube.

3. Pneumatic conveyor according to claims 1 and 2, wherein a bypass of the horizontal conveyor line terminates below the flow tray of the conveying space.

4. Pneumatic conveyor according to claim 1, wherein a mechanical conveyor is installed in the horizontal conveying space, the upwardly narrowing vertical conveyor tube adjoining a discharge end of this mechanical conveyor.

5. Pneumatic conveyor according to claim 2, wherein the flow tray of the horizontal conveying space forms an upper wall of the horizontal conveyor line immediately upstream of the vertical conveyor tube.

6. Pneumatic conveyor according to claim 5, wherein at the discharge end of the conveying space a transition of the horizontal conveyor line into a lower part of the upwardly narrowing vertical conveyor tube is defined by gaps between pipes, guide plates or rods.

7. Pneumatic conveyor according to claim 1, wherein the conveying space provided with the metered grain feed and a length of the horizontal conveyor line together with a lower part of the upright conveyor tube form a unit capable of being removably assembled into the conveyor line.

8. Pneumatic conveyor according to claim 1, wherein the horizontal conveyor line length is provided in its upper cross-section with a baffle, upstream of which the conveyor line is provided with a lateral, chamber-shaped bypass, which bypass terminates below a flow tray of a conveying space lying approximately perpendicular to the conveyor line and having a bucketwheel feed at the top, and that the height of the conveying space having an air feed at the bottom lies in the vertical zone of the lower half of the cross-section of the conveyor line, and the conveying space leads, downstream of the baffle, into the lower part of the vertical conveyor tube.

9. Pneumatic conveyor according to claim 8, wherein the bypass of the horizontal conveyor line is formed as a lateral chamber, which is connected below the flow-plate with the conveying space which is also formed as a

lateral chamber.

10. Pneumatic conveyor according to claim 8, wherein the bucket wheel rotates in one direction, as a result of which the grain emerging from the bucket wheel is directed, together with the flow tray, to the conveyor line.

11. Pneumatic conveyor according to claim 9, wherein the conveyor line with the baffle together with the two lateral chambers, bucket wheel and inlet hopper and together with a connection to the vertical conveyor tube can be inserted or removed as a unit into or from the conveyor line.

12. Pneumatic conveyor according to claim 11, wherein the unit is provided with a pipe connection lying in the direction of the horizontal conveyor line and that this pipe connection or the vertical conveyor tube are provided with shut off means.

13. Pneumatic conveyor substantially as described with reference to Figures 1 and 2 or 3 to 7 of the accompanying drawings.

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